INFORMATION RELATING TO

CURRENTS, ICE AND MAGNETISM,

WITH GENERAL REMARKS ON THE NAVIGATION

OF THE COAST OF

ICELAND.

BY

LIEUTENANT C. F. WANDEL, ROYAL DANISH NAVY.

1879.

[*Slightly altered in Parts.*]

LONDON:
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31, POULTRY, AND 11, KING STREET, TOWER HILL.
1896.

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[*The following information, relating to currents, ice, and magnetism, with general remarks on the navigation on the coast of Iceland, is almost a literal translation of a pamphlet by Lieutenant C. F. Wandel, Royal Danish Navy, published in Copenhagen,* 1879.]

INTRODUCTION.

As a guide for the navigation of the coasts of Iceland only one work exists, namely, the "Lövenörns Beskrivelse," the fourth and last part of which was published in 1822, the greater part of the material for the work having been collected in the previous century. This book, excellent in spite of its age, cannot however supply all the requirements that the seaman, unacquainted with the fairways of Iceland and about to navigate them, might seek for in it. It is properly speaking only a description of the coast and not "Sailing Directions."

Icelandic navigation has hitherto been, as that of Greenland is at this day, a navigation the ship-masters of which have grown up in it from boyhood, and therefore, in a practical manner, learnt its difficulties and its special characteristics, but latterly the conditions have changed. Masters, both of sailing-ships and steamers, who have never seen Iceland, now not infrequently go there to trade, and all have borne testimony to the need for special "Sailing Directions."

Those who have even a little knowledge of the Icelandic fairways will understand that navigation there differs from that of other places. The compass is not the same reliable guide as elsewhere, the great depths render the use of the lead in some places troublesome and useless, and where the lead can be used the charts do not give the necessary information; the irregular and strong currents, the frequent fogs, the long nights, the lack of lights—these, in addition to the violent storms and ice-drift, give sufficient explanation of the special difficulties of navigation.

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ICELAND.

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(C. K. Hundt, [illegible]
1879.)

[illegible]

1879.

A guide for the [illegible]
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3 0 1884—500—1/96 Wyman & Sons.

What is given in the following pages is the result of my own experience during three years' steam-navigation off Iceland. It lies in the nature of the case that I can only give most incomplete information; the long stay in each place, which is necessary for a careful study of the relative proportions, can, if necessary, be carried out with a sailing-ship, but is altogether impracticable in the rapid passing of a steam-ship.

On the other hand, one is in a better position, on board a ship where time is precious, to notice where there is a lack of information and guidance, and to see how such can be supplied. The following pages should give some hints in this direction.

I have lying by a not inconsiderable amount of isolated facts, but in order to their becoming fixed rules they must be observed many times and carefully searched out; if, therefore, all the ship-masters who navigate Iceland, and are interested in the matter, will take notes of the current-rate (adding the accurate time), of the ice and ice-drift, the wind and weather, &c., and will forward the results to me, these pages may at some future date be published in an enlarged and improved form, and their aim be thus attained.

CURRENTS.

The set of the currents near the coast of Iceland is the result of two causes, namely, the ebb and flood streams, and the constant sea currents; I shall therefore give a short description of each of these, in order later on to describe their united working. The ebb and flood streams run in a circular course round the coasts of Iceland, the flood moving with the sun, and the ebb against the sun. On the west coast of Iceland, where the flood sets to the northward, it runs into all the fiords along their southern sides, making its exit on their northern sides, whilst the ebb, which sets to the southward, enters the fiords on their nothern sides and runs out on their southern sides.

On Nordland the flood sets east, on Osterland south, on Sydland west, and the ebb sets everywhere in the contrary direction. On Nordland the flood enters on the western side of the bays and comes out on their eastern side, on Ostland it enters on the northern sides of the fiords and comes out on their southern sides, the direction of the ebb being everywhere exactly the reverse.

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The regularity with which ebb and flood occur in many places, for example near the English coasts, has no parallel near the coasts of Iceland. The reason for this may be found in its isolated position as an island in the midst of the great ocean, where storms and foul weather have altogether a different mass of water on which to work than, for example, in the inclosed North Sea. The extent of the island is also great, and the lofty mountains form a remarkable meteorological boundary, so that one may see it blowing a storm from the east on Synderland, and, at the same moment, blowing a storm from the west on Nordland.

The above mentioned causes are sufficient explanation of the irregularity of the phenomenon.

The ignorance which has existed until lately with respect to the sea currents round Iceland has been dissipated as regards the north and west coasts by the surveys carried out by the screw-schooner *Fylla* in connection with the works of many scientific men* (especially Admiral Irminger).

It has thus been proved that the warm current to the northward (which is to be found the whole year round in the Atlantic ocean) forms a constant current to the southward outside the current along the west coast of Iceland, and to the westward outside the current along its northern coast. In the west and north this warm current is bounded by the cold polar current, which runs down along the east coast of Greenland, after having first, north-east of Iceland, sent an arm down along the east coast of that island.

The distance of the polar current from the west coast of Iceland is not known as yet, but due north of Kap Nord, at a distance of 74 miles, it has been met with as a cold current reaching completely to the bottom. As regards the sea-currents on the east and south coasts of Iceland, science has not as yet declared herself, owing to the lack of sufficient data, or the almost complete absence of such, and what I am about to set forth is built mainly on my own experience and conclusions.

The current running to the eastward along the north coast of Iceland encounters somewhere near Melrakkasletten a cold current

* Those who would become more intimately acquainted with the subject are referred to Captain Hoffmeyer's interesting treatise in the Geographisk Tidsskrifts. I.B. We will not omit to mention that the result to which one is here led has already been set forth by way of conjecture in 1876 by "Einar" (Land-holder and Member of the "Althing," of Næss in Ofjordsyssel) in the "Andvari" Periodical, 3rd annual series; pages 70–74.

The regularity with which [illegible] and land [illegible] many places, for example near the Kilkenny [illegible] of Ireland. The reason for [illegible] as an island in the [illegible] would have altogether [illegible] work than, for example, in the Isle of [illegible] island is also great, and the [illegible] more geological formation [illegible] from the east in Scotland [illegible] adorn from the east of [illegible].

The above remarks [illegible] explanation of the irregularity of the phenomenon.

The ignorance which [illegible] to the sea current [illegible] round Ireland [illegible] and west coasts by the [illegible] especially Atlantic frontiers.

It has thus been [illegible] and (which is to be found [illegible] forms a constant current [illegible] along the west coast of Ireland, [illegible] the current along its [illegible] this warm current is [illegible] runs down along the east coast [illegible] portions of Ireland, [illegible] that island.

The distance of the [illegible] Ireland is not known [illegible], but the [illegible] Sound is [illegible] of 17 miles in [illegible] to the [illegible] possible of Ireland, [illegible] to the lack of sufficient data, or [illegible] and what I am about to [illegible] experience and [illegible].

The current running to the [illegible] coast of Ireland encounters some [illegible]

* These wire worn [illegible] are referred to Captain [illegible] I.H. We will not omit to mention [illegible] already been set forth by way of [illegible] Member of the "Albatross" of [illegible] 3rd annual series, pag. 70 [illegible].

running to the south-west (the above-mentioned arm of the polar current), the westerly part of which, after having struck against Iceland, rounds cape Langanæs in order to join the other part of the current, the course of which is down along the east coast of Iceland. As a current growing narrower and narrower, it continues its course along the south coast, and rounding cape Reikianæs and Skagen, loses itself in Faxe bay. In the south and east this cold stream is bounded by the warm current of the Atlantic ocean, which lies between Iceland and Norway. The warm current along the north coast of Iceland, after having encountered near Melrakkasletten the polar current running towards the south, is perceptible in a northerly and westerly direction, and from thence, in union with the polar current, runs down along the east coast of Greenland.

After this short statement it will at once be noticed how the direction of the dominant sea-current is always coincident with that of the flood stream, and here the elucidation is brought to the standpoint—so often stated by the Icelanders—that the coasts of Iceland are encircled by a constant current running with the sun. Whilst the velocity of the ebb stream will frequently be annulled or considerably diminished by the sea-current, from the union of the latter current with the flood stream, there results a powerful current running with the sun, which consequently appears as the one dominant current.

It is therefore my experience that all navigation round Iceland is effected more rapidly in this direction than in the opposite direction.

Between cape Reikianæs and Skagen, within a distance of 3 miles from the coast, the direction of the flood and ebb streams is respectively north and south. The flood begins to run north 1½ to 2 hours after the time of high water near the land, and flood and ebb streams change with tolerable regularity every six hours; the ebb, although considerably weaker than the flood, is stronger here than at some spots on the west coast. On the south side of Faxe bay the flood runs along the land therefore in an easterly direction, whilst the stream out of the bay has a more north-easterly direction, and the ebb runs in the opposite direction.

In Brede bay the flood stream sets in along the south side and the ebb the reverse; on the north side of the bay, it has been stated to me, that the flood near Stikskaar sets out to the westward of that place and in to the eastward of it, whilst the ebb sets eastward in along the whole north coast. From my own experience I should say that the flood always sets heavily up towards Stikskaar, and there is

therefore every reason to recommend special caution in thick weather when near that point, as a long rocky reef runs out from it. In the western part of Brede bay I have noticed that the ebb sets south-eastward.

Outside all the western fiords, straight up to Straumsnæs, the direction of the flood stream is north-east and that of the ebb south-west; the flood sets, as has already been stated, in on the southern sides of all the fiords and the ebb inversely, and an accurate knowledge of this is therefore of the greatest importance for the navigation of the fiords by sailing vessels.

The flood stream begins to run north at 2 to 2½ hours after the time of high-water in near the land, and runs, as a rule, somewhat longer than the ebb, which is also much weaker. The time of high-water falls later the further off one is from the coast; indeed, it is even stated by the fishermen that, at a distance of 14 to 16 miles seaward, the flood is felt for about three hours longer than in near the land. Vessels which are proceeding to the northward should therefore, towards the end of the flood, keep on the starboard tack, or beat out after it.

On account of the great difference in the strength between the ebb and flood streams, it is always a matter of great difficulty to make southing along the whole of Vesterland.

As regards Isa fiord deep it is to be noted that the current always sets in on the south side, and ships, which with a light breeze intend running into Skutils fiord, must on this account hold close to Hnifdals point, in order not to be set past the fiord by the influence of the current. That Hesteyre fiord on the north side of the deep is always clear of ice is due, I should suppose, to the fact that the current in returning always runs out hard on the north side.

As has already been remarked, the flood and ebb streams on the west coast are subject to great irregularity, notably the ebb cannot be depended on owing to the great strength of the flood; should southerly and south-westerly winds be prevalent for any length of time, the ebb may be altogether wanting, and the current continue to run uninterruptedly to the northward, whilst the flood even with the northerly current will run with tolerable regularity. To this therefore ships should pay special attention.

With strong northerly winds ships must be careful not to get too near to the salient points when the flood is running strongest. This

is specially to be borne in mind near Staalbjerg Hook, as this point causes a violent and short sea, which has sometimes caused considerable damage to vessels, and destruction is certain for open boats at least. The danger near this point is also indicated in the charts by the current race, which extends far out, and is produced not only by the flood-wave coming from the south, but by the entire mass of water which rolls out from Brede bay; the land itself is therefore in this case not to be dreaded, as the current sets out from Staalbjerg Hook. It follows also that the ebb, when running against a strong southerly wind, causes a very short sea.

If coming down with a strong northerly wind or storm against the flood along Staalbjerg Hook, the greatest danger will be over when the south side of the Hook, the so-called "Naeb," shows itself as a step of a staircase; if one be coming with the ebb, then it will only be rightly marked when Stikskaar opens out. Along the west coast, and especially in the vicinity of Staalbjerg Hook, it is not unusual, with the flood at springs, to have a current of 16 miles during the tide, whilst the ebb, as has already been stated, may be altogether absent.

Near Rittershuk, Straumsnæs and Kögur there are also often very strong currents, which, without being so powerful as that near Staalbjerg Hook, are yet dangerous for boats, and must be avoided by small vessels.

Near the north-west point of Iceland the warm current running along the west coast turns eastward and follows along the north coast. The flood-wave is shifted in the same direction, so that here, as on the Westerland, the flood stream is noticeably stronger than the ebb. The seal-fishers have also told me that, at any rate during springs, they can only fish with the ebb northward of Iceland.

In all the bays in the Nordland the flood enters on the west side and runs out on the east side, and the ebb inversely.

In Skagestrand bay, on its west side, the ebb is noticeable no further in than Drangarne; further in than this the current is always entering. In 1878, when I was for three days ice-bound in Reikiar fiord, I saw the drift-ice moving steadily southward. On the east side of the Bay, the current is, as a rule, passing out. On Skage fiord it should be the same, and a like state of things takes place in Ofjord, where the continually out-going current is strongest on the east side.

The explanation of this lies in the well-known fact that in the northern hemisphere all currents running in a northerly direction

have a tendency to diverge towards the eastward, whilst the currents running south have a tendency to diverge to the westward.

The current turns here also two hours after high-water, but is unreliable, as on the west coast, and here as there the flood is the most constant.

The direction of the warm current along the north coast alters, as has already been stated, near Melrakkasletten, because, on meeting with the westerly part of the branch of the polar current, which runs down along the east coast, it first turns off in a northerly direction. and, after taking a north-westerly and westerly direction, follows on with the cold current running north of Iceland. The above-named branch of the polar current, which has a south-westerly direction, by this means is turned somewhat aside, so that, in a southerly direction, it works down towards the north coast of Iceland situated eastward of Melrakkasletten, which it then follows in an easterly direction out round cape Langanæs.

The meeting place of the above-named currents varies according to the season of the year; in the summer months it is somewhat more easterly, in the winter somewhat more westerly. The difference is not, however, great, and I believe that the meeting place is usually on a line northward from the east side of Melrakkasletten.

The following are the grounds on which the conclusions to which I have been led relative to the currents in this place are based :—

1. The temperature of the water as taken here, because the same temperature, which is met with in the cold current to eastward of Iceland, is always met with almost up to the above-named meeting place.

2. The absolutely regular drift on this spot. When sailing from cape Langanæs westward, one will always come much nearer to Melrakkasletten than the course is set, which is therefore due to the drift to the southward of the polar current. When sailing further westward, Grimsey will always come in sight more southerly than one expected, the which displacement is due to the divergence in a northerly direction of the warm westerly current.

When steering from Langanæs westward, in foggy weather, caution is therefore necessary; when proceeding to the eastward in a fog, should it lift and allow the Ness to be sighted, it is also necessary to exercise caution to pass outside it, as a vessel will certainly be astern of her reckoning.

In clear weather I was once obliged, in order to pass clear of the Ness, to steer half a point up for half an hour.

3. There is the powerful current, which almost always exists out from Langanæs, which may in part be due to the mass of water thrown up against it by the polar current in its encounter with the north coast, as it seeks to pass out round the Ness.

In the exceptionally strong ice year, 1859, when the Nordland was completely blocked until far into the summer, the powerful current near cape Langanæs kept open water in its immediate vicinity, and rendered existence possible for the inhabitants of the adjacent "Fuglebjerge."

4. That the above-named meeting place coincides with the limit of the fog. It is a fact well known to mariners, that the fog near Langanæs seldom comes further in than to Melrakkasletten; even with westerly winds this rule holds good. To my thinking this affords proof that the cold and warm currents here encounter each other.

5. That drift timber, which is in such abundance on the west and north coasts, is never met with on the east coast.

6. There is also the confirmation resulting from the ice-drift, as will be shown later on.

That the foregoing explanation relative to the currents on Nordland is a rule which admits of exceptions, I am not prepared to deny. Persistent westerly wind will naturally displace the above-mentioned meeting place, and it may also happen that the warm water will over-flood the cold, as I have assured myself by means of temperature measurements.

As has already been stated, the east coast is washed by a cold northerly current, a branch of the polar stream. The word "cold" must not, however, be taken in the same significance as above, where the water referred to was at zero, or below the temperature of zero. The reason for this is, I take it, that one has here to do with a comparatively weak branch of the polar stream, which for a long while, before it approached Iceland, has been surrounded on either side by warm water, very seldom carrying ice, and that, finally, it is not a deep-lying, but only a surface current, with greatly varying extent and breadth. That it is very variable in extent may be gathered from the exceedingly varying temperatures, which may be obtained on the same spot at quite short intervals of time. Its presence, I believe, will, however, as a rule be

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demonstrated by a sudden fall of 3° to 5° in the temperature at a distance of 15 to 20 miles from land. In May 1876, however, I met with water below zero at a distance of 50 miles south-east of Dalatangen.

A part of this northerly current, as well as of the easterly on Synderland, is possibly only an eddy of the warm current northward; an eddy to which is constantly conveyed cold water from the many rivers which characterise the east coast and, more especially, the south coast.

A cold current running southward, and later on, westward, does however, exist, but our ignorance with regard to the relative currents in both places, is a void, which can only be filled in by systematic scientific research—not by the chance passing of a single ship. I shall therefore not go further into this point, the more so that I have not been able to make even the few foregoing remarks without trenching on the carefully considered work of Professor Mohn.

The ebb and flood streams are much weaker here than on the west coast, where the maximum rise of tide is as much as 16 feet, whilst here it barely attains to 9 feet; the constant sea current therefore also exercises great influence on the speed of the ordinary current. The cold current coming from the north is coincident with the flood, causing it so greatly to preponderate that, as a rule, during the space of 12 hours one can reckon on the flood stream running 7 hours and the ebb 5.

From Langanæs the current sets down towards Glettinganæs and then continues to flow down along the coast, decreasing considerably in breadth and strength until near to Dalatange, but it increases in strength again from that point southward. Partly on account of some noticeably high temperatures which I have found off Dalatange I consider that there is here an offset of the northerly current, the rate of which, near Langanæs, is considerable; going with the flood, a set of 12 miles is not unusual, on which account, when sailing round cape Langanæs in foggy weather, one must proceed with great caution. Off the southern part of the east coast, for example outside Berufiord, one may encounter, with the flood, as strong a northerly current as near Langanæs. Near Langanæs the lead can, however, serve as a guide, as one ought not to get soundings below 33 to 35 fathoms.

In thick weather it is always necessary to bear in mind that one is certain to be more southerly than the course steered.

The flood stream runs from 2 to 3 hours after the corresponding hour of high water in near the land, but is also liable to the greatest irregularity; with strong northerly winds, the ebb is almost entirely absent. At its commencement the flood sets more towards the land than at its close, whilst the ebb sets more off the land. The flood sets in on the north sides and out on the south sides of all the fiords, and the ebb the reverse, but this last is rarely noticeable more than a third of the distance into the fiords. The periods of the year when the great masses of snow melt naturally afford an exception to this.

With respect to the south coast, our knowledge of the current is, as has been already stated, but small. According to the measurements of the temperature of the water, taken at the meteorological station on Westmanöerne, it is however satisfactorily proved that the warm Atlantic current, during the whole year through, lies at no great distance from the coast. I consider that the said current, on encountering the south coast, divides itself into a branch flowing eastward and a branch flowing westward at a point, which in each case lies east of the Westmanöerne (the Westman islands) as due south of these islands, so soon as one is beyond the influence of ebb and flood, there is always an easterly current.

Along the whole of Synderland there runs the very narrow westerly current already several times mentioned, which, after having rounded Reikianæs and Skagen, terminates in Faxe bay. The flood and ebb streams appear to follow the direction of the coast, thus they set relatively more north-west and south-east near the Westmanöerne and more west and east to eastward of them. They are here, also, exceedingly irregular and very dependent on the prevalent winds. Near Westmanöerne it is often noticed, with or shortly before strong east winds, that the ebb is entirely absent and that the current is easterly during several days.

ICE.

One of the worst evils for Iceland is the drift ice, which at certain seasons of the year visits its coasts; and is not only one of the worst hindrances to navigation and to the fisheries, but also, by reason of its influence on the climate and, through that, on vegetation and animal life, causes great disturbance and disaster on land.

No rules can be laid down as to the coming of the ice; for two or often three years in succession it may be almost entirely absent, whilst years of strong ice may occur singly or for several years in

succession. So far as I have been able to discover from the scanty notes existing in this respect, the ratio of the years in which there has been ice to those in which it has been absent is as seven to ten, of these first, however, there are some which are specially remarkable for their severity, as for example 1859, 1869, and 1878. The ice appears also at different periods of the year, which fall, however, between December and April; by *ice* I mean here such great masses as to hinder navigation—not fragments and icebergs, which may be met with at all seasons of the year.

The ice, as a rule, first shows itself near the North Cape, but never in considerable quantities, unless there have been previously violent north-westerly and westerly storms.

The forces which move the ice are the currents and the wind; of these the currents must first be mentioned, as they are the more powerful, partly because they have a greater mass to work on, since a floating iceberg is in volume some seven or eight times greater below the surface of the water than above it, on which account the ice may frequently be seen to continue moving with no little speed directly up against the wind, and partly because the current is a very much more constant or persistently steady force than the wind. Violent storms are naturally a powerful factor in the movement of the ice, but the storms alone never cause the ice to travel with any great rapidity; should current and wind work together the ice may then be hurried along at a rapid rate.

Should ice approach Kap Nord from the westward, it is carried along the Nordland by the there dominant easterly current at a greater or less distance from land, until, near to Melrakkasletten, it is carried back to the polar current by the warm current running here north-north-west and afterwards west.

The powerful current entering along the west side of Skagestrand bay can indeed carry small masses of ice with it and these have frequently been seen to be carried far in against a moderate gale; large masses of ice are, however, only carried into the bays when the ice, drifting along the Nordland, encounters strong northerly or north-westerly storms, which overcome the force of the westerly current and pack the ice in on the land, accompanying this with a heavy snowfall. Should the ice be driven in with force in this manner, Melrakken, Skagen and the other salient points are as so many arms to imprison it,—which hold fast the ice and will not let go their hold; it might in this way appear as though the ice came from

[illegible] Sound [illegible] been [illegible] to [illegible] from the only [illegible] in [illegible] at the [illegible] the year, in which there [illegible] [illegible] which it has been [illegible] is as open to [illegible] [illegible] there are some which are generally navigable for a [illegible] for example 1839, 1859, and 1876. The ice [illegible] [illegible] of the year, which fell, however, between December and April, is now [illegible] such great masses [illegible] [illegible] not frozen and [illegible], which may be seen [illegible] all [illegible] of the year.

The [illegible] [illegible] the North Cape, but never in considerable quantities, unless they have been previously broken [illegible] [illegible].

The [illegible] which [illegible] the streams and the wind; of these the streams [illegible] [illegible], as they are the more powerful agents. [illegible] they [illegible] greater mass to work on since a floating iceberg [illegible] some seven or eight times greater below the surface of the water than above it, on which account the ice [illegible] to continue moving with so little apparent [illegible] wind, and partly because the current is very much [illegible] or perpendicularly more than the wind. Ice [illegible] are naturally a powerful source in the production [illegible] alone never cause the ice to travel with any great regularity, [illegible] current and wind work together [illegible] a rapid rate.

Should ice approach Kap [illegible] from the westward, it is carried along by the Norland by the [illegible] easterly current at a rate of [illegible] from [illegible] to Mellankaleton, it is carried [illegible] the powerful current running here [illegible].

The [illegible] [illegible] along the west side of Skagestrand bay can indeed [illegible] small masses of ice with it and those have frequently [illegible] carried far in against a moderate gale; [illegible] [illegible] carried into the bays when the [illegible] Nordland [illegible] strong northerly or northeasterly [illegible] much overcome. The force of the westerly current [illegible] the land, accompanying this with a heavy sea [illegible] the ice [illegible] in with force in this manner. Mellankaleton and the other adjacent points are so much [illegible] to [illegible] which both [illegible] the ice and will not let go their [illegible] [illegible] as much the ice came from

the north-east, but this view is erroneous, and this will be understood by the foregoing explanation, and by the fact that ice never comes in on the Nordland without having first been seen near the North Cape. The ice, which is borne to the coast in this manner, is very lasting, partly because it always appears in great abundance, and partly because the frost, which always accompanies the north-easterly wind, quickly transforms it into a compact mass. North-westerly winds also frequently bring ice in on the north coast, but never in such great or such compact masses.

In the first-named manner great masses of ice are carried intact along the Nordland, but encounter, near Melrakkasletten, violent northerly storms, so that the current is hindered from carrying the ice northward; the ice then turns towards the land and eastward, where Thistil bay becomes filled with a firm sheet of ice, whilst the salient point Langanæs puts a stop to the further onward passage of the ice; should the ice, however, continue to press in from the west, the fixed ice will increase in bulk and Langanæs will no longer hold it back, and it is now carried by the polar current down along the east coast, probably in combination with the ice, which the polar current was itself carrying; encountering here easterly storms, it is packed into the fiords and bays of the east coast, although but seldom north of Gerpir Hook. It has, however, been seen, although but rarely fixed, the whole way down to Hornene, but never on Synderland, where only a few times in this century, can it be remembered that even great, insulated hummocks have been seen.

The ice, as has been already stated, makes its appearance from December to April; should it arrive after the middle of March, it is considered late and very disastrous, as it may be expected that it will remain lying for a long time. This is, however, a rule which has many exceptions; it appears, however, a fixed rule, that when the ice comes before 13th of March, it will go with the equinoctial spring tides, accompanied by violent southerly gales. For what period of time the ice will remain lying, when it arrives late, does not appear to be subject to any distinct law, although it has never remained later than 23rd August. As a general rule, making exception of the years when the ice is strongest, one can reckon on being unhindered in passing the Nordland after the last days of May.

So long as the ice drifts in the sea north of Iceland, the weather is very variable and stormy. Fog and snow are frequent and even a strong breeze rarely lasts more than twelve hours, but so soon as the

ice has become fast to the land, the weather changes to calm with a clear sky and light frost.

As has been already stated, both current and wind have great influence on the ice drift, but combined, they exercise complete dominion over it; if the ice has become fast to the land, and strong frost combined with considerable pressure from the offing has welded it into a compact mass, it is then only the united force of wind and current that can drive it away. It appears that the effect is strongest when the wind blows almost fair on the current, on which account a south-east gale is the most effective for the Nordland, and a south-west gale in respect to Osterland.

The rate at which the ice can set in or can be withdrawn is incredible. I will give two examples of this. Sysselmand Sveinbiörnson relates having seen fixed ice one morning from Husefiord as far as his eye could reach; suddenly he heard a cracking and crashing, and one piece of ice after another loosened, until, in the space of five hours, all the ice had disappeared. The other example is of later date. On 5th June, 1876, in the afternoon the ice lay fixed, from the Skagestrand as far as one could see to seaward; the next morning not a single block was to be seen. The explanation of this last is given in the "Meteorological Year Book" and the Almanac (Meteorologisk Aarbog)—a fresh S.E. gale was blowing and there was a new moon, and thus a strong current.

It is quite an exceptional thing, when the ice reaches Osterland before reaching Nordland, the which ice must in such case be carried by the polar current. The ice always leaves Osterland first, the most powerful agent in effecting this, being, as has already been stated, a south-westerly gale; it is carried to seaward and is always brought northward by the warm stream existing east of Iceland.

When the ice leaves the Nordland it first follows the coast eastward and is afterwards carried away in a north-westerly direction. In this I see also a confirmation as to the change in the direction of the warm current near Melrakkasletten, for I have never heard that anyone, after the ice has left the Nordland, has found it on the east coast, which must have been the case, if, instead of being carried north near Melrakkasletten, it had been carried out to eastward in the polar current which runs along the east coast.

Great masses of ice, as has been stated, left the Nordland on 6th June, 1876; a few days after I passed the east coast and went

past Langanæs without meeting with a single block of ice and without, over this reach, receiving any answer save *No* to my question as to whether anyone had seen any ice.

Along the Vesterland ice may also be seen in years when the weather is severe, but it never becomes fixed, affords no hindrance to navigation, properly speaking, and seldom reaches beyond Patricksfiord.

The ice that one encounters near the coasts of Iceland has various origins, it either comes from Greenland or from Spitzbergen; the first is the most usual, and this, which always comes in first, is the so-called Greenland ice-floes, consisting of great level flats of ice over 30 feet thick; the second consists exclusively of ice-bergs of greater or less size, which are often so great as to touch the bottom in depths of 60 to 70 fathoms. This last may arrive together with the floe-ice, when this has drifted for any time north of Iceland and afterwards been set down on the coast by northerly or north-easterly gales, but, I believe, that most frequently it arrives as isolated ice-bergs, which may occur far on in September. In 1877 I encountered on 22nd September, off Skagestrand bay, an ice-berg, the height of which was 66½ feet, and the circumference of which must have been at least 2000 feet, whilst a couple of others were seen stranded upon the coast.

The frequent fore-runner of the ice is fog, the greatest caution being therefore necessary at places where one may expect to meet with it, and it has been proved by the three years' navigation of the mail steam-ship *Diana*, that the whole year through, at least on the Nordland, one will meet with ice, although only during a few months in such quantity as to put a stop to navigation.

A sudden fall of several degrees in the temperature of the water, especially when the temperature approaches zero, or is below zero, is a certain sign of the proximity of ice; on the other hand, the detached ice-bergs, which are more especially met with in the autumn, are not heralded by any fall in the temperature; these ice-bergs give notice of their immediate vicinity, even during the thickest fogs, by a brightness round them, which brightness answers to the so-called ice-blink, always hovering in the air over great masses of sea ice. As an example of the rapidity and suddenness of the advent of the ice, even in the beginning of April, and of the excellent guidance afforded by the thermometer, I shall mention that, being in Seidis fiord, I noticed a sudden fall in the temperature of the

water from 4° to zero, in the afternoon, and we immediately set sail. Next day the fiord was full of ice.

What has been stated in the foregoing pages will make it readily understood, what a hindrance and peril the ice is to navigation on the north and east coats of Iceland, especially when one considers the masses and the dimensions in which it appears, and the rate at which it can travel. About the middle of March the ships of the factories begin to arrive; should the east coast be blocked, then the ships must keep to sea and at a distance from land, in order to avoid coming into collision with the ice when it is going away; the greatest security at that time of year will be to seek shelter at Berufiord, but, as has already been stated, the ice is less frequent on the east coast.

Should ships be bound to the Nordland, and it be found blocked with ice, the ice will, as a rule, be met with at Langanæs. Any attempt to out-flank it in the north will be of no avail, and there is nothing to be done save to keep to sea, if one does not wish to put into port. I should in such case, also, recommend Berufiord, and most distinctly dissuade from the more northerly harbours or bays, where the ice, when it escapes cape Langanæs, might come in and not only shut in, but also damage the ships. There have been examples of ships, which, awaiting on Vapnafiord the departure of the ice from Langanæs, have been cut in pieces by the ice.

There is yet another expedient, and this is of special use to ships, which are bound for the western half of the Nordland, namely, by going southward and westward of Iceland, to endeavour to approach from the westward; as the drift of the ice is towards the east, there have been numerous examples of such an experiment being attended with success, and this mode of procedure has the further advantage, that, should the way to the North cape be also barred, one can await the departure of the ice in one of the western fiords, where the ship will lie secure.

A little later in the year, when the ice no longer forms any masses welded fast together, there may be a question of going amongst it, and it has repeatedly been seen, that ships, which have ventured themselves near Langanæs, after a day of difficult navigation, have found open water. The ice will frequently, also, more especially to the westward, leave a narrow channel between it and the land, where ships have often worked through successfully and have reached their destination. Both these expedients require experience and

[illegible] day the [illegible] was full of [illegible]

[illegible] as has [illegible] what a hard [illegible] the [illegible] the [illegible] the [illegible] [illegible] the [illegible] [illegible] the ships must [illegible] and [illegible] coming in collision with the [illegible] [illegible] [illegible]

courage; in the first case the ship may be crushed to pieces, and in the second she may be pressed in on the land. With the prospect of southerly and westerly winds and the near proximity of spring, I consider that there is very much less risk in going within the ice than in going into a mass of ice, unless the said mass shall consist of tolerably scattered flat sheets and blocks of ice. A steamer is, of course, in an entirely different position.

With regard to navigation between the blocks of ice, I must not omit to draw attention to the base, projecting far out under the water, which most of these ice-blocks have, also that one must not turn sharply round an ice-block, as they are as hard as rocks, before the summer has advanced; and, lastly, that should a ship get fast in the ice, she should at once get boats and provisions clear, as it might then be but the work of a moment for her to be crushed to pieces.

It is impossible to give detailed rules for navigation of ice; it will come by practical experience, a right judgment with respect to wind and weather, and rapid carrying out of the determinations arrived at.

VARIATION OF THE COMPASS.

As has already been remarked in the Introduction, the compass, in the Icelandic fairways, does not afford the same secure guidance as it does in other places; this is due partly to the high magnetic latitude, and partly to the influence of magnetic minerals in the land at the bottom of the sea. The mountains, which are of volcanic structure, contain a great deal of iron, and the bottom of the bank of soundings under 100 fathoms seems to be of a similar nature, judging from well-authenticated reports, that the compass has been disturbed in a vessel 5 or six miles from the coast.

The compass, from Westmanöerne to cape Reikianæs, along the north coast, along the west coast, and down along the east coast to Kollemule Hook is quite reliable, and not subject to any great or sudden disturbance. One must, however, make exception at Faxe bay where deviations of up to 3° occur, especially when passing the Buder Bank shoal and South and West Hrauhn. A vessel steering across Faxe bay from Joklen to Reikiavik, must therefore reckon on a mean variation of 37° W., and from Skagen to Reikiavik, a mean variation of 36° W. Further, on the above-named space may be noted the environs of Akero, west side of Skagestrand bay, and the north side of Tjornenæs, where the compass is very sluggish. This is also

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

the case, according to the statement of the screw-schooner *Fylla*, Captain Jacobson, in 1877, for a space N.W. of Isafiord Deep; within a distance of two miles from land, I have, however, noticed nothing of the kind.

For the whole of the east coast and the easterly part of the south coast, on the contrary, the testimony of all the ships' commanders is a general complaint as to the unreliableness of the compass; this seems, however, to me to be somewhat groundless.*

With respect to the south coast, where my own experience is certainly less, I have not any ground, either, to distrust the compass. I am, however, inclined to give a caution with respect to the immediate vicinity of Portland, partly because I have myself noticed some irregularity here, and partly because the testimony of different masters regarding the unreliability of the compass on this spot, is unanimous.

If I have stated above that I consider complaints on this score somewhat groundless, with respect to the east coast, it is because I consider that two causes have been mistaken, the one for the other.

The east coast is, as a rule, enveloped in fog; often, for the space of several days, ships have to lie waiting before they can set the course on it, whilst there is constantly a movement caused by the frequently irregular set of the current, and when the fog lifts and the land can at last be recognised, the position does not answer to the dead-reckoning, and the blame is thrown on the compass. I have several times heard the captains of vessels assert that the compass is unreliable in foggy weather; they forget, that in foggy weather they go slowly, and that by the influence of the current and the wind, their reckoning is in fault, and not the compass upon which fog has no effect.

What has also added to the apparent unreliability of the compass, is that the variations indicated on the charts have, until quite lately, been much too great.

Finally, it is to be regretted that one fact is so entirely forgotten, that the deviation in this latitude is different to that which has been

* My own experience is, that beyond a distance of half a mile from land, one can place full reliance on the compass, and it is only within that distance that I have seen the compass affected; this especially is the case in the distance lying from Clettinganæs until a short distance south of Skruden, where, close in to the land, and in the fiords, the variation may be seen to decrease suddenly as much as a whole point.—(*Lieut. Wendal.*)

[illegible]

[illegible] the [illegible] the [illegible] have [illegible] pass [illegible] wonder [illegible] the wind, [illegible] which for [illegible]

What [illegible] is the [illegible] been much too [illegible]

Finally, it is to [illegible] that [illegible] that the [illegible]

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* [illegible] can [illegible] have [illegible] and [illegible] point.—(Anna. [illegible])

found by observation at home. The permanent magnetic influence of the ship upon the compass is indeed pretty much the same, but the induced magnetism in the vertical soft iron varies according to the tangent of the dip.

For a ship which is to cruize in Icelandic waters, the ordinary practice of ascertaining the error of compass by frequent observations is especially necessary.

Anyone, intending to occupy himself with enquiries into the variation as regards navigation, must do so at sea; to bring a compass ashore is useless, as in many places, by shifting the compass only a few feet, a difference of several degrees may be obtained in the corresponding variations.

GENERAL REMARKS.

Making the coast of Iceland divides itself under two heads, according to whether the ship's course be to the westward or the southward of the island. Vessels, proceeding westward, attempt as a rule to sight land at Portland and afterwards steer southward of the blind Fugleskiær; for making Portland the hundred fathom line is a good guide. With the prospect of a steady fair wind a sailing vessel can easily proceed northward of the Fugleskiærene (or the Fugle skerries) and in round Reikianæs, but if the wind shift round with south-west or westerly gales, a vessel is but badly placed in Örebak bay, where it would be certain destruction to strand. At only one spot on this coast has it once happened that a ship has got ashore and has saved her crew, namely, close westward of the mouth of the river, which empties its waters to westward of Örebak.

It is not sufficient, either, to recommend that ships should remain at a distance from the south coast of Iceland, and the numerous shipwrecks, especially of French fishermen, whose spring fisheries begin here, are telling evidence of this. It is especially on the coast east of Portland that ships are set so violently in by the westerly current, and it is seldom that any ship, which has approached the coast incautiously, has been able to claw off from it. Moreover, the mariner is here deceived by the coast, which is so low that it cannot be seen at all, before one is right close under it, this effect being not a little increased by contrast with the high but distant background.

The route southward of the Fugleskiærene must have absolute preference during the bad season of the year.

[illegible]

[illegible]

[illegible]

Ships obliged to go east and north or which are bound to the east coast, must seek to make out the land between Gerpirhuk and Glettinganæs ; there are here many remarkable mountains, such as : Huusgavlene, Hornnæs, etc., etc., and the coast has the advantage over this reach, of being perfectly clean and, even during fogs, one can, wind and weather permitting, run close to it, as the breakers always rebound at a distance of two cable lengths. To proceed round Langanæs without having seen the land and without a tolerably good estimate of one's position, I cannot consider to be right.

Ships bound for the southern harbours on the east coast, may also, with off-shore winds, endeavour to make the east or west Horn, but will have more difficulty, in case of a sea-wind, in clawing off the shore. On the southern part of the east coast one must during fog (if in any uncertainty as to one's position) keep outside a depth of 60 fathoms.

What has here been said is of course less important to steamers or sailing vessels at the fine weather season of the year.

Even entering the fiords may frequently be attended with great difficulty, because, even when there may be an on-shore gale in the offing, the wind may be blowing strongly out from the fiord, or there may be a perfect calm.

In the fine weather season of the year there are regular sea and land breezes, known as *Landgaale* and *Hangaale*, of which it is well to make use in connection with the already-mentioned direction of ebb and flood streams. In order to profit by these one must, however, work with the wind, across the fiord, keeping a close luff on the lee side. Under the lee the wind falls very light, striking up against the high mountain-wedge ; on the weather side also the mountains stop the wind, on which account the eddy winds are all the more felt.

One difficulty attendant on the navigation of the fiords lies in the fact, that the amount of sail carried must be less than that ordinarily carried when sailing, on account of the violent squalls from the mountains, which may be very dangerous for sailing ships. There is special ground for caution in respect to these, when the clouds lie heavy and low down on the mountains ; should the clouds, on the other hand, keep more to the mountain tops, be lighter and drive quickly before the wind, the danger is less, and the squalls will, in any case, be lighter,

Ships obliged to go east and north or which are bound to the east coast, must seek to make out the land between Gerpinnk and Gletthingenes; there are here many remarkable mount ins, such as: Hunsgavlene, Hornnes, etc., and the coast has the advantage over this reach, of being perfectly clean and, even during fogs, one can, wind and weather permitting, run close to it, as the breakers always rebound at a distance of two cable lengths. To proceed round Lindesnes without having seen the land and without a tolerably good estimate of one's position, I cannot consider to be right.

Ships bound for the southern harbours on the east coast, may also, with off-shore winds, and more so in make the east or west Horn, but will have more difficulty in case of a sea-wind, in clewing off the shore. On the southern part of the east coast one must during fog (if in any uncertainty as to one's position) keep outside a depth of 60 fathoms.

What has here been said is of course less important to steamers or sailing vessels at the time of the year or season of the year.

Even entering the fiords may frequently be attended with great difficulty, because, even when the wind may be an on-shore gale in the offing, the wind may be blowing strongly or it from the fiord, or there may be a perfect calm.

In the time weather season of the year there are regular sea and land breezes, known as Aamlgavvik and Aftengavvik, of which it is well to make use in connection with the ebb-succession of direction of ebb and flood streams. In order to proceed by these one must, however, work with the wind, as a rule, keeping a close luff on the lee side. Then in the lee the wind fills very light, striking up against the high mountain ridge; on the weather side also the mountains stop the wind, so that account the eddy winds are all the more felt.

One difficulty attending on the navigation of the fiords lies in the fact, that the amount of wind varies very much, so that sailing vessels carried when sailing, on account of the rise of squalls from the mountains, which may be very dangerous for the ship. There is special ground for caution in regard to those, when the clouds lie heavy and low down on the mountains; should the clouds, on the other hand, keep more to the mountain tops, be lighter and drive quickly before the wind, the danger is less, and the squalls will, in any case, be lighter.

Should one, as has been above stated, meet with a sudden calm when entering a fiord, it might be recommended, as a good precautionary measure, to have a boat lowered so as to assist when tacking or towing as soon as one gets into smooth water.

On the north and east coasts fog is the worst hindrance to navigation. As regards the north coast the cause for this must be sought in the encounter of the still distant cold current (always carrying ice) with the warm current; a fresh northerly wind, therefore, will almost always bring fog. Not only for fog but for the weather in general there are on this coast two meteorological boundaries, namely, Skagen and Melrakkasletten; the value of these is, however, not so great with northerly winds as with other winds.

Without attempting to enter into any explanation of the question, I will merely call to mind that I have already made mention of the fact that fog almost regularly ceases near Melrakkasletten, when coming from the eastward. In Skagestraus bay one has frequently very different weather from that which exists to eastward of Skagen, and the same holds good for Melrakkasletten, as one will often pass by into a calm, after having experienced a strong breeze on Osterland.

The east coast is much more infested by fog than the north coast. In Beru fiord it is stated that there were 186 days of fog in 1874; there are no notes in respect to the north coast, but on Stikkesholm, during the same year, it is stated that there were only 7 days of fog.* The cause of fog may also be sought in the fact that the two currents, the cold current coming from the north and the warm current from the south, encounter each other.

Although one may have fogs with all winds, yet the westerly are the worst, and these are by far the most prevalent; thus, on Beru fiord in 1874 there was a westerly wind for 222 days. There is, moreover, this inconvenience with westerly winds: fog lies close down on the mountains, whilst with easterly winds, there is usually a belt left, between the fog and the coast, about half a quarter-mile in breadth, so that, when one has passed through the fog, the coast lies perfectly clear. Further southward on the east coast, and in any case from Papos, the circumstances are somewhat altered, that is: westerly and south-westerly winds here bring clear weather, whilst the sea wind almost always brings fog and rain.

* "Andvari," 1876, page 72.

Should one, as has been above stated, meet with a sudden calm when entering a fiord, it might be recommended, as a good precautionary measure, to have a boat lowered so as to assist when backing or towing as soon as one gets into smooth water.

On the north and east coasts fog is the worst hindrance to navigation. As regards the north coast the cause for this must be sought in the encounter of the still distant cold current (always carrying ice) with the warm current; a fresh northerly wind, therefore, will almost always bring fog. Not only fog but for the warmer in general show are on this coast two meteorological boundaries, namely, Skagen and Melankalsleiten; the value of these is, however, not so great with northerly winds as with other winds.

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The east coast is much more visited by fog than the north coast. In Iceland it is stated that there were 180 days of fog in 1874; there are no notes in respect to the north coast, but on Seydisfjordur, during the same year, it is stated that there were only 7 days of fog.* The cause of fog may also be sought in the fact that the two currents, the cold current coming from the north and the warm current from the south, encounter each other.

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* "Aarbøger," 1876 page 72.

On the south coast fogs are much more rare, and on the west coast they are altogether exceptional, as has been stated above.

The barometer is not either so sure in its indications as to the weather in Iceland as in other places. The reason of this lies in the high mountains of the island which cause the weather to be exceedingly different at places within a comparatively short distance from each other; one may lie with a calm in one fiord, whilst a fresh breeze is blowing in the neighbouring fiord, but this must necessarily affect the barometer. It will very often happen that on leaving the sea and entering a fiord, or inversely, an alteration of one to two millimetres will take place in the height of the barometer.

In the deep fiords of Iceland it is always difficult to judge of the weather at sea. As an example, I shall state what I have myself seen. The war-schooner *Fylla*, on one of the western fiords, with both anchors down, drove before the wind out of the fiord, whilst one hour later we encountered a dead calm at sea, and the sea was so smooth as to make it evident that there could have been no wind for a long time past.

The peaks of the highest mountains can always serve as a guide to forming a judgment of the coming weather. Clear, cloudless peaks, or the peaks surrounded by loose, light clouds, generally signify calm and fair weather, whilst thick, woolly grey clouds and heavy clouds are indications of foul weather. On the west coast Essiö, near Reikiavig, and the Snefjeldsjoklen are note-worthy weather prophets.

The Snefjeldsjoklen on the westerland forms a meteorological boundary similar to that of the Skagen and Melrakkasletten on the Nordland.

As a rule it may be accepted that in all the Icelandic fiords and on the coasts, the gales will increase with the flood tide, also that the afternoon high water is always higher there than the forenoon high water.

Good places for taking in water are to be found at Reikiavig, Havne fiord, all the western fiords, of which that in Talknar fiord, Svendssyre, gives warm water, also Ofjord, Seidis fiord, Eske fiord, Faskrud fiord and Beru fiord,

The best anchorages for ships are Reikiavig, Svendssyre on Talknar fiord, Svendssyre on Dyre fiord, Ofiord and Seidis fiord.

For determining the time of high-water a list is here given for different places of the period of time, which must be added to the time of high-water, which is found for each day in the Almanac published by the Observatory of Copenhagen; and the sum resulting is the hour of high-water in the forenoon at the place in question. Should the resulting time be greater than 12 hours, then subtract twelve hours from it, and the remainder will give the time of high-water in the afternoon. The number of feet indicate the spring range.

	H.	M.	
Alptanæs (Faxe-bay) - - - -	5	17	
Reikiavig - - - - -	5	24	- 14 Feet.
Budenstad - - - - - -	6	25	
Thingeyre - - - - - -	6	45	- 11 Feet.
Flateyre - - - - - -	7	31	- 11 „
Isafiord - - - - - -	7	32	
Adelvig - - - - - -	8	10	
Akneyre - - - - - -	9	30	
Husevig - - - - about	9	25	
Vapnafiord - - - - - -	0	12	
Dalatange - - - - - -	0	30	
Vestdalseyre - - - - -	0	50	
Watsnæs (Rode fiord) - - - -	2	00	
Djupavog - - - - - -	3	10	- 9 Feet
Papos - - - - - about	4	0	- 9 „
Westmano - - - - - -	4	50	- 12 „

With respect to the proper time for the navigation of the coasts of Iceland, this would fall (especially for Nordland and Osterland), according to my thinking, between 1st April and 15th October, and outside this period, the navigation here is an unjustifiable traffic with human life and merchandise, a view fully borne out by the numerous shipwrecks which take place yearly. Ships, which are sent up to the Nordland or the Osterland in March, often spend a month in waiting for the ice to move, exposed to violent storms and to the danger of getting into the ice, and the fearful storms of October and November have cost the lives of many seamen.

It is the underwriters who should put in a word, for, so long as ships can be insured, so long this loss of life and unjustifiable navigation will continue.

[illegible] Redlands [illegible]
[illegible] 6 [illegible]

[illegible] the place [illegible] 12 [illegible]

[illegible]	5 [illegible]	
[illegible]	5 [illegible]	1 [illegible]
[illegible]	6 [illegible]	
[illegible]	[illegible]	[illegible]
[illegible]	7 [illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	8 [illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	0 12	
[illegible]	0 [illegible]	
[illegible]	0 59	
[illegible]	[illegible]	
Djupavog	3 [illegible]	[illegible]
Papos	1 [illegible]	[illegible]
Westmann	1 5 [illegible]	12 [illegible]

With respect to the [illegible] for the navigation [illegible] of Iceland, this would fall in [illegible] for [illegible] and [illegible] according to my thinking [illegible] 1st April and the Oct [illegible] on this period, [illegible] hurricane and [illegible] ships [illegible] the Norman [illegible] the Oceland [illegible] them, often spend a month waiting [illegible] danger [illegible] lives of [illegible]

[illegible] should [illegible] can be instead, [illegible] navigation [illegible]

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